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OLOGIT ANALYSIS OF DETERMINANTS OF VULNERABILITY TO FOOD INSECURITY BY COCOA FARMING HOUSEHOLDS IN SOUTHERN ASUNAFO, REPUBLIC OF GHANA

Purpose. Using ologit analytical tool, this study examined the determinants of vulnerability to food insecurity by cocoa farming households in Southern Asunafo, Ghana and assessed the coping strategies adopted by the farmers against food shortage related shocks.

Methodology / approach. A two-stage sampling procedure was used to elicit cross sectional data from a total of 150 cocoa farmers across the 11 settlements in the study area using a semi-structured questionnaire. CARE and WFP (2003) Household Coping Strategy Index (CSI) and Factor analysis were used to determine vulnerability to food insecurity status of the households and ordered logit regression was used to identify the determinants of vulnerability. The data was analyzed using STATA software.

Results. Findings from the study revealed that 35.33 % of the households were moderately vulnerable while 33.33 % and 31.34 % were mildly and severely vulnerable respectively in the study area. Borrowing food, eating seed stock, begging for food and reducing meals were the major coping strategies adopted by the households. The ordered logit regression result shows that being a female household head increases the probability of being vulnerable. Age of household head was found to be significant ($p < 0.05$) and negatively influencing Vulnerability to food insecurity. Household dependants and number of coping strategies were found to be significant ($p < 0.05$) and positively influencing Vulnerability. Education level, farm income and labor hour use were found to be significant ($p < 0.1$) and negatively influencing vulnerability. Marital Status, Access to extension and off-farm occupation were significant ($p > 0.05$) and negatively influencing household vulnerability to food insecurity among the households.

Originality / scientific novelty. Author's developed econometric model is very useful is empirically assessing determinants of vulnerability of cocoa farming households to food poverty in southern Asunafo district, and to form a basis for decision making regarding achieving food security in Southern Asonafo. The proposed method offers great potentials for achieving safe, nutritious, and accessible food security condition amidst the challenge of food poverty.

Practical value / implications. The study concluded that policies that address the major determinants of vulnerability such as education, off-farm occupation, access to extension services and income diversifications with emphasis on cocoa female farmers' empowerment are will enhance resilience of rural farming households to food insecurity in the study area.

Key words: Food insecurity, Vulnerability, determinants, Ologit, Cocoa, Ghana.

Introduction and Review of Literature. More than 820 million people in the world are still hungry today, underscoring the immense challenge of achieving the Zero Hunger target by 2030 FAO (2019). Food security and food insecurity are at opposite extremes of a spectrum. The importance of investigating food security is necessitated by the events of increasing population (Ogundari, 2017). Sub-Saharan

Africa is the most vulnerable region to food insecurity and Ghana is one of the food deficit countries in sub-Saharan Africa (FAO, 2019). In Ghana, people living in smallholder households, who represent 46 per cent of the total population, have limited access to agro-climatic information and financial services needed to invest in farm equipment and quality inputs (Nicholas et al, 2019). The global understanding of food security comprises of various concepts such as ecological, social, economic and political aspects that help to recognize the choices and problems that determine whether people have enough resources to consume the food they need and desire.

Food security is a condition that exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active healthy life (FAO, 2018). Thus the increasing evidence of change in population and available food production has generated contention and empirical question. This suggested disparity indicate that low rate of food production and high rate of population growth can generate high rate of food demand, thereby causing food Demand-Supply gap which can give rise to food insecurity. In literature, the idea of vulnerability is used with different implications. Much of the disaster management literature use vulnerability with reference to a natural hazard (Bogale et al, 2016) while the food security literature, and part of the social risk management and poverty literature (WFP, 2019) defines vulnerability in relation to an outcome, such as hunger, food insecurity or famine. Vulnerability refers to people's propensity to fall or stay below food security threshold within a certain time frame (Løvendal and Knowles, (2005)).

Many empirical studies including Darkwah and Verter (2014), Verter and Becvarova (2014), and Bernard et al (2018) have been conducted regarding Ghana's cocoa (*Theobroma cacao*) production and export, however, few studies have been conducted regarding the welfare of the producers of cocoa, especially the determinants of vulnerability to food insecurity of the cocoa farmers in southern Asunafo of the country. Despite the great volume of cocoa production and export in Ghana, a great number of cocoa farmers are still faced with the challenge of food poverty (Taylor, 2017); it is however imperative to inquire into how cocoa farmers adapt to food shortage related shocks in Ghana.

Asunafo South District located in the Southern part of the Brong Ahafo Region of Ghana. The District lies between latitude 6° 10' and 6° 45' North and longitude 20° 45' West and 0° 45' East. It has a total area of 3737 km². The district is rural in nature with 83 % of the population living in rural settlements. The rest of the 17 % of the population resides in urban areas. The district is dominated by crop cultivation/production with Cocoa contributing about 80 % of the total crop sub-sector activities. The rural dominance of the District population can be attributed to the predominance of the agricultural sector in the district.

There are three main approaches to vulnerability measurement, Vulnerability as Expected Poverty (VEP), Vulnerability as low Expected Utility (VEU) and Vulnerability as Uninsured Exposure to Risk (VER). Both the VEP and the VEU approaches employ the same measure in analyzing vulnerability, the VEU approach,

however, takes into consideration covariate shocks unlike VEP, while the VER assesses whether observed shocks generate welfare losses (Oni and Yusuf, 2008). This study used the VEP approach because of data limitation. There are shortcomings in using cross-sectional data approach to infer vulnerability because it captures only idiosyncratic risks and does not address covariate risks (community and national related risks) (Oni and Yusuf, 2008).

Various studies carried out in developing countries have highlighted a number of factors considered as determinants of household's vulnerability to food insecurity status. Taylor (2017) assessed the food security status and production constraints of cocoa farming households in the Ashanti region of Ghana and reported that 73 % and 27 % of the households were food secure and insecure respectively. Adepoju and Yusuf (2012) in the study on poverty and vulnerability in rural South-west Nigeria reported that a total of 324 (55.7 %) households were vulnerable using the relative poverty line of N3313.57 estimated for the study. This result indicates that vulnerable households were higher than the proportion actually poor in South Western Nigeria. This finding is in line with findings from other study by Graaff et al (2016) in which the proportion of vulnerable is greater than the proportion of households actually poor. Adepoju and Yusuf (2012) also recommended in this study that poverty alleviation programs must focus not only on those factors which aggravate poverty but also vulnerability in order to employ several specialized approaches to tackle these multifarious problems.

Using data from 320 randomly selected cocoa producing households, Antwi et al (2018) conducted a survey on the analysis of food security among cocoa producing households in Ghana and found that 67 % of the sampled households were food insecure indicating high level of food insecurity among cocoa producing households in the country. They also reported that In particular, female-headed households were found to be more food insecure than male-headed cocoa producing households in the study area.

Irin (2012), conducted an analysis of livelihood and food security status of households and vulnerable groups in Zimbabwe, Zambia and Malawi. It was found that female-headed households were more vulnerable to food insecurity in the three countries; rural women were poorer than men and had turned to casual agricultural labour as a primary source of income.

Bernard et al (2019) conducted a research in Ghana and reported that about 5 % of Ghana's population are food insecure and about 2 million people are vulnerable to become food insecure in the country.

Ogundari (2017) in a study on Categorizing households into different food security states in Nigeria: the socio-economic and demographic determinants found that households that consume only home produced food have high probabilities of being food insecure, while households that consume only market-purchased food are less likely to be food insecure. According to him, the implication of this finding is that harmonization of food security indicators helps identify households with different nature of food (in) security problems that require different types of policy

interventions most especially in Nigeria.

Purpose of the article. The general objective of this study is to examine the determinants of vulnerability to food insecurity among cocoa farming households in Asunafo District, Ghana while the specific objectives of the study are to determine the level of vulnerability of cocoa farming households to food insecurity in the study area, profile households' vulnerability by their socio-economic characteristics, identify the factors determining vulnerability of the households to food insecurity, examine the coping strategies adopted by the households against food-shortage and related shocks.

Results and discussions. This study examined the determinants of vulnerability to food insecurity among cocoa farming households in Asunafo District, Ghana. Factor analysis was used to group the CSI scores into three levels of vulnerability (Mild, moderate and severely vulnerable). Descriptive statistical technique was used to profile the vulnerability level of the farmers by their socio-economic characteristics. Likert scale was used to analyze the coping strategies adopted by the household against food shortage related risks. Ordered Logistic regression was used to analyze the factors determining vulnerability of the households to food insecurity. The ordered logistic model is specified below:

$$\Pr(Y_i > j) = \frac{\exp(\alpha_j + X_i\beta_j)}{1 + [\exp(\alpha_j + X_i\beta_j)]} \quad j = 0 - 2$$

Where Y_i = the dependent variable reflecting the 3 categories of vulnerability to food insecurity by the cocoa farming households:

$Y_i = 0$; Households who are mildly vulnerable (base group);

$Y_i = 1$; Households who are moderately vulnerable;

$Y_i = 2$; Households who are severely vulnerable.

α_j = the intercept term, β_j vector of parameter to be estimated, X_1 age of the household head (years), X_2 household size, X_3 sex of household head (Male=1, otherwise =0), X_4 marital status, X_5 farm income (cedis), X_6 education of household head (years), X_7 food expenses (cedis), X_8 access to extension services (yes = 1, 0 = otherwise), X_9 number of days incapacitated by sickness, X_{10} labor hours use (hour), X_{11} off-farm occupation (Yes = 1, 0 = otherwise), X_{12} number of dependants, X_{13} farm size (hectare), X_{14} number of coping strategies, X_{15} non-food Expenses (Cedis).

Level of Households Vulnerability to Food Insecurity. Table 1 showed that, out of 150 households that were sampled, only 33.33% were mildly vulnerable, 35.33 % were moderately vulnerable while 31.33% were severely vulnerable to food insecurity in the study area.

Distribution of Households by Vulnerability Level

Vulnerability category	Frequency	Percentage
Mildly vulnerable	50	33.33
Moderately vulnerable	53	35.33
Severely vulnerable	47	31.34
Total	150	100,00

Source: Field Survey (2018).

Classification of Households by Vulnerability Index. Classification of households into vulnerable groups is essential to know the cut-point for the household food insecurity status for necessary intervention programs (Ogundari, 2017). Table 2 below revealed the distribution of the respondents with respect to their vulnerability index. The result shows that households who range between 0-0.4 are the vulnerable ones who are still able to cope, those with index 0.41-0.46 are the ones that need urgent but temporary external assistance to get out of shocks while the ones with emergency levels are those with index between 0.47 and 0.84.

Table 2

Classification of Households according to the Range of their Vulnerability Index

Vulnerability category	HH situation	Vulnerability Index	HH Percentage
Mildly vulnerable	In a vulnerable situation but still able to cope	0 to 0.4	33.33
Moderately vulnerable	Needs urgent but temporary external assistance to recover	0.41 to 0.46	35.33
Severely vulnerable	Emergency level HHs	0.47 to 0.84	31.34
Total			100,00

Source: Author's computation (2018).HH=Household.

Profile of Household Vulnerability Status by Socio-Economic Characteristics.

Age of Household Head. Table 3 below revealed that 8, 11 and 10 out of every 29 farmers who are less than 41 years old were mildly, moderately and severely vulnerable respectively in the study area.

Table 3

Distribution of Household Vulnerability by Age

Age(years)	Mild	Moderate	Severe	Total
≤ 40	8(16)	11(20)	10 (21)	29
41 – 50	39 (78)	36(67.92)	29(61.7)	104
51 – 60	3 (6)	5(9.43)	6(12.77)	14
>60	0	1 (1.9)	2 (4.3)	3
Total	50	53	47	150

Source: Field survey (2018). Figures in parentheses are percentages.

A total number of 104, 14 and 3 out of 150 households had ages between 41 and 50, 51 and 60, and greater than 60 respectively in the study area. This means that more than one-third of the households were relatively mildly vulnerable to food insecurity. The table also revealed that farmers who were more than 60 years old were severely vulnerable to food insecurity in the study area.

Household Size of Respondent. Table 4 below revealed that 10, 8 and 12 out of every 30 farmers who headed household size which were less than 4 members were mildly, moderately and severely vulnerable respectively in the study area. A total number of 103 and 17 out of 150 households had household sizes between 4 and 7, and greater than 8 members respectively in the study area. The result shows that vulnerability were fairly distributed among household who had households greater than 8 in the study area. The majority (103) of the farmers had between 4 and 7 family members, the possible explanation of this is that more than two-third of the

farmers had household sizes below 8 members.

Table 4

Distribution of Household Vulnerability by Household Size

HH size	Mild	Moderate	Severe	Total
≤ 3	10 (20)	8(15.09)	12(25.53)	30
4 – 7	35(70)	38(71.70)	30(63.83)	103
≥ 8	5(10)	7(13.21)	5(10.64)	17
Total	50	53	47	150

Source: Field survey (2018). Figures in parentheses are percentages.

Farm Size of the Respondent. Table 5 below revealed that 15, 15 and 6 out of every 36 households who had farm size less than 0.8 hectares were mildly, moderately and severely vulnerable respectively in the study area. A total number of 63 and 51 out of 150 households had farm sizes between 0.8 and 1.2, and greater than 1.6 hectares respectively in the study area. The result also showed that Majority of the households who are severely vulnerable were those who cultivate lower amount of farmland in the study area and this may be the possible explanation behind their higher vulnerability status.

Table 5

Distribution of Household Vulnerability by Farm Size

Farm Size(ha)	Mild	Moderate	Severe	Total
≤ 0.4	15(30)	15(28.3)	6 (12.77)	36
0.8 – 1.2	16(32)	20(37.74)	27(57.4)	63
≥ 1.6	19(38)	18(33.96)	14(29.79)	51
Total	50	53	47	150

Source: Field survey, (2018). Figures in parentheses are percentages.

Farm Income of the Respondents. Table 6 revealed that 1 and 3 out of every 4 farmers who earn less than 3,000 cedis per month were mildly and severely vulnerable respectively in the study area. A total number of 110, 30 and 6 out of 150 households had farm income between 3,001 and 13,000 cedis, 13,001 and 23,000, and greater than 24,000 cedis per month respectively in the study area. Farm income is crucial to the welfare of the farmers. The result also revealed that among the farmers, those who were severely vulnerable are those who earn less amount of farm income.

Table 6

Distribution of Household Vulnerability by Farm Income

Farm Income (Cedi)	Mild	Moderate	Severe	Total
≤ 3,000	1(2)	0	3(6.4)	4
3,001 – 13,000	39(78)	37(69.8)	34(72.3)	110
13,001 – 23000	8(16)	13 (26)	9 (19.1)	30
≥24,000	2(4)	3(5.66)	1 (2.1)	6
Total	50	53	47	150

Source: Field survey (2018). Figures in parentheses are percentages.

Education Level of Household Head. Table 7 below revealed that 13, 16 and 23 out of every 52 farmers who only had primary education were mildly, moderately and severely vulnerable respectively in the study area. A total number of 14 and

84 out of 150 households had secondary and tertiary education respectively in the study area. This means that more than two-third of the respondents had tertiary level of education and the consequence of this is reflected in their relatively low severity of vulnerability.

Table 7

Distribution of Household Vulnerability by Education Level

Education Level	Mild	Moderate	Severe	Total
Primary	13(26)	16(30)	23 (48.93)	52
Secondary	8(16)	3(5.6)	3 (6.38)	14
Tertiary	29 (58)	34(64.1)	21(44.68)	84
Total	50	53	47	150

Source: Field survey (2018). Figures in parentheses are percentages.

Number of Dependants of Households. Table 8 below revealed that 43, 43 and 29 out of every 109 households who have less than 3 household dependents were mildly, moderately and severely vulnerable respectively in the study area. A total number of 30 and 11 out of 150 households had between 3 and 5, and greater than 5 dependents respectively in the study area. This means that more than 72 % of the farmers had less than 2 household's dependents in the study area. Result also showed that among the household with the greatest number of dependents, those who are severely vulnerable have the highest number of household dependents.

Table 8

Distribution of Household Vulnerability by dependents

Dependents	Mild	Moderate	Severe	Total
≤ 2	43(86)	43(81)	29(61.7)	109
3-5	7(14)	12 (22.6)	11 (23.4)	30
≥ 6	0	4(7.5)	7 (14.89)	11
Total	50	53	47	150

Source: Field survey (2018).

Sex of Household Head.

Table 9

Distribution of Household Vulnerability by Gender

Sex of HH Head	Mild	Moderate	Severe	Total
Female	15(30)	10 (18.86)	20(42.5)	45
Male	35(70)	43 (81)	27 (57.4)	105
Total	50	53	47	150

Source: Field survey (2018).

Table 9 above shows that male-headed households are more vulnerable than female headships. But one must be careful while analyzing this result as sample size in both groups is different. Male headed households are more than 2 times greater than female headed households in study area. About 70 % of the households are male headed. This result is consistent with previous study by Welderufael (2014). However, among the female heads, the number of vulnerable households are more than those who are mildly vulnerable. It should be noted that the logistic regression result shows that female headed households are more vulnerable than male headed

households and significant at 10 % level of probability.

Econometric Results. Although 15 variables were hypothesized to be correlated with vulnerability to food insecurity, the ordinal Logistic regression result confirmed that only 10 factors were significant (at $p \leq 0.1$) in influencing households' vulnerability. Accordingly, among variables fitted into the model (Table 10), age of the household head, marital status, education level, number of household dependents, farm income, non-food expenses, access to extension services, labor hour use, off-farm occupation, numbers of coping strategies were found to be significant in determining household vulnerability to food insecurity.

Table 10

Ordered Logit Coefficient Estimates for the Determinants of Vulnerability to Food Insecurity

Variables	Coefficient	Standard Error	Z	P> z
Age (X ₁)	0.0934685	0.0286897	3.26	0.001***
Household Size (X ₂)	0.069463	0.096621	0.72	0.472
Sex of HH head (Male) (X ₃)	-0.2498703	0.386263	-0.65	0.518
Marital Status (married) (X ₄)	-0.521623	0.2748845	-1.90	0.058*
Education Level (X ₅)	-0.6669171	0.3094742	-2.16	0.031**
Farm size (X ₆)	-0.0412473	0.117478	-0.35	0.726
Farm income (X ₇)	-6.52e-05	2.66-e05	-2.45	0.014**
Dependents (X ₈)	0.345322	0.1244206	2.78	0.006***
Non-food expenses (X ₉)	9.24e-05	4.85e-05	1.91	0.057*
Access to extension (X ₁₀)	-0.724759	0.4331992	-1.67	0.094*
Labor hour use (X ₁₁)	-0.1977927	0.1022943	-1.93	0.053**
Off-farm occupation (X ₁₂)	-0.6482449	0.3840906	-0.69	0.091*
Food expenses (X ₁₃)	-7.59e-06	3.47e-05	-0.22	0.827
Coping strategy (X ₁₄)	0.1081576	0.0402323	2.69	0.007***
Days incapacitated by sickness (X ₁₅)	0.0630359	0.1416702	0.44	0.656
μ_1	3.005051			
μ_2	5.009322			

Source: Field Survey (2018). Number of observation =150, LR $\chi^2(15) = 57.61$, Probability > $\chi^2 = 0.0000$, Pseudo $R^2=0.1750$, Log likelihood = -135.80514. * Significant at 10 %, ** Significant at 5%, *** Significant at 1 %.

The estimated cut-off points (μ) satisfy the conditions that $\mu_1 < \mu_2 < \mu_3$. This implies that these categories are ranked in an ordered way. The first cut-off point ($Y=0$ for “mildly vulnerable group”) was used as a mark for the purpose of comparison. Estimated coefficients are presented in table 10 and marginal effects in table 11. The independent variable signs are interpreted with respect to the base, mildly vulnerable.

Estimated coefficients from an ordered logit model are difficult to interpret because they are in log-odds units; as such, the marginal effects (Table 11) are discussed. The marginal effects, calculated at the mean of the continuous independent variables, were provided by STATA 12 based on either continuous or discrete variables. Marginal effects are interpreted relative to the category and sign. A positive coefficient for a category indicates an increase in that variable increases the

probability of being in that category, whereas, a negative coefficient indicates a decrease in probability of being in that category. Nine variables have significant marginal effects (p values ≤ 0.1) in two equations: age of the household head, marital status, education level, and number of household dependents, farm income, non-food expenses, labor hour use, off-farm occupation and numbers of coping strategy used.

A unit increase in age of the household head will cause 1.872 % decrease in probability of the household being mildly vulnerable, 0.07 % increase in the probability of the household being moderately vulnerable and 1.799 % increase in probability of the household being severely vulnerable to food insecurity in the study area. Age is significant at 1 % level of probability and has a positive relationship with food insecurity in both the moderate and severely vulnerable categories but not significant in the moderately vulnerable group. This finding is consistent with previous studies by Opiyo (2014) and Babatunde et al, (2008) who found that elderly farmers are relatively less productive in rural communities of Kenya and kwara State of Nigeria respectively.

The possible explanation of this result is that as age increases, vulnerability to food insecurity tends to increase in moderately and severely vulnerable households. Age is an important socio-economic factor determining how vulnerable a household could be. Households headed by persons above the mean age of 45 years are more likely to be vulnerable compared with the younger persons in the study area. Consequently, elderly household heads are probably worse off in terms of labor strength and preparing strategies to cushion their families against adverse food security threats and impacts and likely to make them more vulnerable.

The coefficient of marital status (married) of the households is both negative and significant at 10 % level of probability in both moderate and severely vulnerable groups. But it is positive in the mildly vulnerable groups. It means that married people who stay together are less likely to increase the probability of being moderately and severely food insecure by 0.04 % and 10 % respectively than single or married household heads who are separated or widowed in the study area. This result is similar to study by Elijah (2010) who concluded that married couples were likely to be more food secure than single headed households. Education level coefficient is positive and significant at 5 % level of probability in mildly vulnerable households but negative and significant at 5 % level in severely vulnerable households while it is negative but not significant in the moderately vulnerable groups. The implication of this is that as more people get educated in the study area, the probability of the households being mildly food insecure increases, the chances of being moderately and severely food insecure decreases respectively. This is due to the fact that education equips individuals with the necessary knowledge of how to make a living. This result conforms to previous studies by Welderufael (2014) and Antwi (2018) who found that the effect of education on food security works indirectly by influencing the actions of the farmers in how to make a living.

The table also shows that a unit increase in the male headship will lead to 0.0003428 increase in the probability of being in moderately vulnerable group and

0.0488 increase in probability of being in the mildly vulnerable category while it will reduce the probability of being in the severely vulnerable group by 4.9 %.

Table 11

Marginal Effects of the Ordered Logit Regression

Indicators	Mildly Vulnerable				Moderately Vulnerable			
	dy/dx	S.E	Z	P> z	dy/dx	S.E	Z	P> z
Age	-0.0187	0.0057	-3.24	0.001***	0.00072	0.00279	0.26	0.796
Household Size	-0.0139	0.0194	-0.72	0.474	0.00053	0.00223	0.24	0.811
Sex of HH head (Male)	0.0488	0.07393	0.66	0.508	0.00034	0.00832	0.04	0.967
Marital Status (married)	0.1044	0.0551	1.89	0.058*	-0.0040	0.01567	-0.26	0.797
Education Level	0.1335	0.0623	2.14	0.032**	-0.00514	0.02005	-0.26	0.798
Farm size	0.0082	0.0235	0.35	0.725	-0.000318	0.00153	-0.21	0.836
Farm income	1.31e-05	1e-05	2.43	0.015**	-5.03e-07	1e-05	-0.26	0.797
Dependents	-0.0691	0.0249	-2.78	0.006***	0.00266	0.01031	0.26	0.796
Non-food expenses	-1.85e-05	1e-05	-1.91	0.056*	7.12e-07	1e-05	0.26	0.797
Access to extension	0.1567	0.0993	1.58	0.115	-0.0315	0.03924	-0.80	0.421
Labor hour use	0.0396	0.0205	1.93	0.054**	-0.00152	0.00593	-0.26	0.797
Off-farm occupation	0.1355	0.0832	1.63	0.103*	-0.0177	0.0257	-0.69	0.491
Food expenses	1.52e-06	1e-05	0.22	0.827	-5.85e-08	1e-05	-0.17	0.869
Coping strategy	-0.0216	0.0081	-2.67	0.008***	0.000833	0.00324	0.26	0.797
Days Incapacitated by sickness	-0.0126	0.0283	-0.45	0.656	0.00048	0.00216	0.23	0.822

Continuation of Table 11

Indicators	Severely Vulnerable			
	dy/dx	S.E	Z	P> z
Age	0.0179	0.0056	3.21	0.001***
Household Size	0.0133	0.0185	0.72	0.471
Sex of HH head (Male)	-0.0492	0.0777	-0.63	0.526
Marital Status (married)	-0.1004	0.0532	-1.89	0.059*
Education Level	-0.1284	0.0598	-2.15	0.032**
Farm size	-0.0079	0.0226	-0.35	0.725
Farm income	-1.26e-05	1e-05	2.42	0.015**
Dependents	0.0664	0.0242	2.74	0.006***
Non-food expenses	1.78e-05	1e-05	1.88	0.060*
Access to extension	-0.1251	0.0666	-1.88	0.061*
Labor hour use	-0.0380	0.0198	-1.92	0.055*
Off-farm occupation	-0.1177	0.0660	-1.78	0.074*
Food expenses	-1.46e-06	1e-05	-0.22	0.827
Coping strategy	0.0208	0.0077	2.67	0.008***
Days Incapacitated by sickness	0.0121	0.0273	0.44	0.657

Note. The dy/dx are for the discrete change in the qualitative 0–1 variables. S.E = Standard Error. * Significant at 10%, **Significant at 5%, ***Significant at 1.

Source: Field Data Analysis (2018).

The possible explanation is that female headed households are more severely

vulnerable to food insecurity than male headed households in the severely vulnerable category. This might be due to the fact that female headed households do have less access to and control over major agricultural resources even though they do much of the agricultural work. In addition, plowing (digging) of land is done manually in the study area as opposite to other parts of the country, where oxen are used for this purpose. This finding is consistent with findings of Kassie et al (2012) and Ndobbo and Sekhampu (2013) who found that female headed households in South African Township are traditional and physically incapable of performing plowing activities as such, hence, they are found among the poor and lack income and resources that constrain their productivity.

A unit increase in farm income will increase the probability of being in the mildly vulnerable category, reduce the probability of being in moderately and severely vulnerable category respectively. The coefficient of this variable is significant at 5 % level of probability for both the mildly vulnerable and the severely vulnerable groups. The negative effect indicates that an increase in monthly farm income will reduce the chances of a household becoming severely and moderately food insecure in the study area. This finding is consistent with previous studies by Nicholas et al (2019).

A unit increase in the number of dependent will increase the probability of being in severely and moderately vulnerable category while reducing the probability of being in the mildly vulnerable category. This variable is significant at 1 % level of probability in both mild and severely vulnerable group but not significant in the moderately vulnerable category. The implication of this result is that the more dependents a household has, the less likely to be mildly vulnerable and the more likely for it to be moderately and severely vulnerable since a larger proportion of household resources are directed to dependents who cannot contribute much toward household welfare. This finding is consistent with the findings of Opiyo (2014).

The coefficient of Non-food expenses is significant at 10 % both for the mildly and severely vulnerable households but not significant for the moderately vulnerable households. This variable has an inverse relationship with food insecurity in the mildly vulnerable groups and a direct positive relationship with the severe and moderately vulnerable groups. The implication is that a unit rise in spending on non-food items will reduce the probability of a household being mildly food insecure and increase the likelihood of the household being moderately and severely food insecure.

A unit increase in Access to extension services will increase the probability of a household being mildly vulnerable. This increase will reduce the chances of being moderately and severely vulnerable to food insecurity in the study area at 10 % level of probability respectively. This is because contact with extension services tends to enhance the chances of a household having access to better and improved varieties of crop. Access to extension services is believed to be crucial for food production, because it gives the farmers the opportunity to learn new production techniques that can increase their yield and improve their present and future food security situation. This result is consistent with the findings of Ayantoye et al (2011) and Bernard et al,

(2019).

The coefficient of Labor hour use is negative both for the moderate and severely vulnerable groups respectively implying that a unit rise in hours spent on farm labor will reduce the probability of the households being moderately and severely food insecure. The coefficient for this variable is positive and significant at 5 % for the mildly vulnerable group indicating that a unit increase in labor hour will increase the likelihood of being mildly vulnerable by 3.9 %. More energy expended at work means greater work done, this can accelerate production, harvesting and processing of crops on the farm thereby contributing to total output and reducing food insecurity likelihood more than the case where less hours are spent on labor. A unit increase in off-farm occupation will reduce the probability of a household being moderately and severely food insecure and increase the chances of being mildly food insecure. This variable is not significant for the moderately vulnerable groups but significant for both mildly and severely vulnerable respectively at 10 % level of probability. Access to employment opportunities help to diversify and increase amount of income received by households. The marginal effects also shows that a unit rise in food expenses will increase the probability of being in mildly vulnerable groups by 0.0015 % and reduce the probability of being moderately and severely vulnerable to food insecurity by 0.00000058 % and 0.00000146 % respectively in the study area. As the number of coping strategies increases, the likelihood of being mildly vulnerable reduces, the chances of being moderately and severely vulnerable increases in the study area. This variable is significant at 1% for the mild and severely vulnerable groups respectively.

Coping Strategies. Figure 1 below show the graphical result of the Likert scale analysis of the coping strategies.

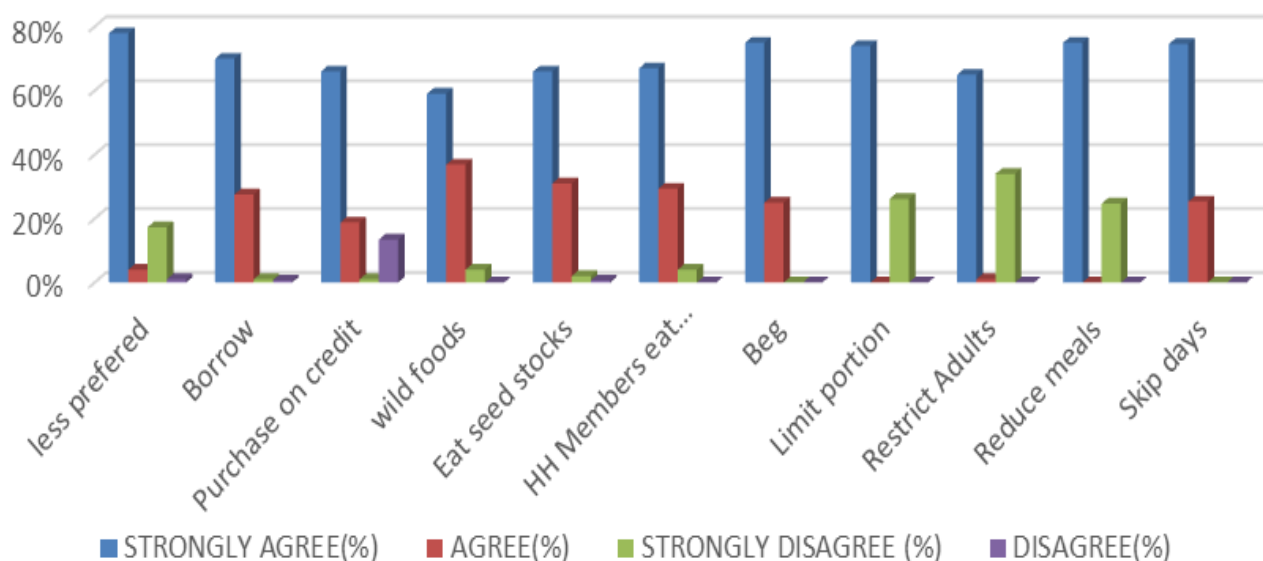


Fig. 1. Consensus Ranking of Household Coping Strategies

Source: Field Survey, (2018).

The graph above shows that 78 %, 74 %, and 75 % of the total households strongly agreed that relying on less preferred food, limiting portion of food and

reducing meals respectively are the least severe coping strategy in the study area. About 70 %, 66 % and 67 % of the total household chose borrowing food, purchasing food on credit and allowing household members to eat elsewhere as moderately severe respectively. About 59 % 75 %, and 75 % of the households chose gathering of wild foods, begging for food and skipping days without eating as very severe respectively. About 66 % and 65 % of the households strongly agreed that eating seed stock and restricting adults at meal are severe respectively.

Conclusions. Based on the findings from this study, it is concluded that there is a little difference among the cocoa farming households in terms of the three categories of vulnerability to food insecurity; mild (33.33 %), moderate (35.33 %) and severely vulnerable (31.34 %). The vulnerability status is fairly distributed. The findings also revealed that the households vary in vulnerability by socio-economic characteristics and that female headed households are more vulnerable to food insecurity than male headed households in the study area. The study also concluded from the result of the ordinal regression that an increase in all resources of the farmers will reduce their vulnerability to food insecurity at $p \leq 0.1$. The farmers could reduce their vulnerability if more active youths and more educated farmers are engaged in farming than the elderly ones in the study area, hence it can be concluded that policies that address these determinants of vulnerability with emphasis on women's empowerment, education and income diversifications are likely to enhance resilience of rural farming households to food insecurity.

The study recommended that the government of Ghana should assist the Asunafo district to empower female headed households by providing them with professional education with regards to ways of improving food access. Access to extension services and education level were regarded as significant determinant for household food insecurity. It is therefore vital that the government promote agricultural education and extension services in the study area, by encouraging households to participate in food gardening/farming activities as a source of generating extra income. It is advised that incentives such as quality cocoa seeds are provided to households in order to encourage them to engage in subsistence farming. The number of household dependents was a significant determinant for household food security; therefore it is important to educate the community about family planning in order to encourage households to plan for smaller family sizes, particularly for female-headed households.

The government cannot do everything, off-farm occupation was a significant determinant of vulnerability to food insecurity in the study area, and hence the private sector should implement more strategies through Private-Public-Partnership (PPP) for addressing the issue of food insecurity at household level. This can be done by conducting workshops, entrepreneurial programs and support groups, in which people can be trained to ensure that they improve their dietary intake and quality foods.

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